ATTACHMENT 1

These techniques use biomass of greater concentration and, above all, of greater activity than activated sludge and have the following advantages:

- savings in land space, particularly due to elimination of the wastewater clarification stage. This compactness makes it easier to cover units, control harmful effects (smell and sound) and produce aesthetic units,
- no risk of leaching since the biomass is attached to a support such that flow variations can be readily handled,
- easy adaptation to dilute wastewaters,
- quick restarting, even after stopping for several months,
- modular construction and easy automation.

Oxygenation can be carried out by prior dissolution of atmospheric oxygen or pure oxygen, or by direct transfer of air into the reactor. In the latter case, the respective flow directions of air and water are particularly significant. The practice of filtration of drinking water has led, as an initial approach, to the development of downflow reactors with countercurrent air flow; this technique leads to the slowing down and the coalescence of the injected air bubbles, hence the formation of gas pockets in the granular mass. This is the phenomenon of **air binding** which involves the following disadvantages:

- increase in the head loss leading to reduction of the treated water flow and an increase in the washing frequency,
- need to continuously (and uselessly) increase the process air flow: this no longer becomes necessary because of the biological needs, but because of the mechanical and hydraulic needs,
- this excessive injection of air causes turbulence reducing the SS retention capacity.

These different reasons led Degrémont, in the case of direct transfer, to select air-water cocurrent techniques, either in upflow (**Biofor**), or in downflow (**Biodrof**). There is one exception, however: nitrification of drinking water in which clear treated water is also desired. The negligible concentrations of SS in the effluent to be treated, together with the low growth rate of the nitrifying bacteria, considerably limit clogging and, consequently, the risks of air binding. In this case it is possible to use an air-water countercurrent (Nitrazur process).

Each biofiltration technique, by virtue of its particular characteristics, has a very precise application.

2.2.1. Filter media: Biolite

The filter media has a dual role:

- support of microorganisms,
- filtering effect.

The choice of a suitable support is fundamental and depends on the type of reactor being considered and the nature of the wastewater to be treated (drinking water, MWW or IWW, after pretreatment, primary settling or secondary biological treatment).

Degrémont developed a family of materials called Biolite (L, P, F) whose ES can vary from 1 to 4 mm and granular density from 1.4 to 1.8 $g.cm^{-3}$. They have the following common characteristics:

- surface conditions favourable to bacterial development,
- low friability and low loss in acid.

2.2.2. Biofor (Biological Filtration Oxygenated Reactor)

2.2.2.1. Description

This is a system of **aerobic biological filtration with air and water upflows** (Figure 407). Oxygenation is thus carried out by introduction of air cocurrent with the water.

A Biofor installation mainly comprises (Figure 408):

- a battery of identical reactors generally made of concrete (1), operating in parallel (or possibly two batteries in series, in the case of combined removal of carbonaceous pollution with nitrification),
- a unit for distributing the water to be treated (2),
- an access gallery to the automatic valves and pipework, to the filter bottoms, drains, etc. (3),
- an adjoining bay for the backwash pumps (4),
- a bay for the various air blowers and compressors (5),
- a treated water tank for wash water (6),
- possibly a tank for recovery of the waste wash water, with drainage pumps (7).

Each reactor, comprised of a rectangular, concrete pit, includes:

- a feed well for water to be treated, equipped with a protecting screen,
- a support floor for the granular media, made of prefabricated slabs,
- two front-mounted weirs, with surface sloping upstream for collecting the treated water and the wash water. These weirs are protected by a material trap comprised of a stilling picket fence eliminating turbulence, particularly in the air scour + water washing sequence of the washing cycle (Figure 409),
- a front-mounted treated water collecting trough for each reactor, and a part of the waste water collecting channel shared with the battery of reactors.

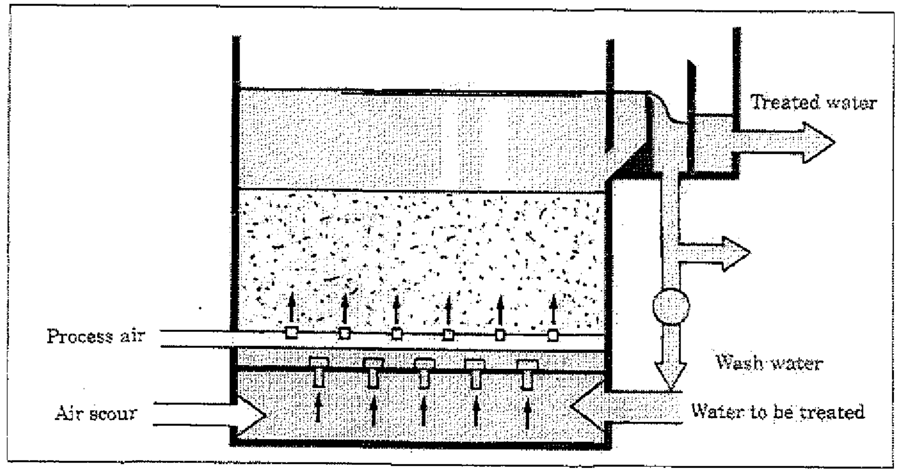

Figure 407. The principle of the Biofor